Space Weather Technical Forecast

Issued on Thursday, 16 November 2023 at 01:06 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with a number of C-class flares. The largest of these were at C8.3 at 15/0401 UTC and C7.7 at 15/1212 UTC. These were from AR3485 which is no longer visible as it rotates over the southwest limb. There are now four sunspot regions on the disc. Of the three numbered regions, the largest is AR3486 in the southwest, however this persists as an inactive and small bipolar region. The other regions are very small, including the newly developed and unnumbered spot in the northwest. There were no Earth-directed CMEs, although a large far-sided eruption was visible to the northwest.

Solar Wind / Geomagnetic Activity: Solar winds were initially at background, but have shown a very slight increasing trend in terms of speed, rising from 360km/s to around 400-430 km/s. Density was largely at or just below average. Total magnetic field strength (Bt) was weak, in the range 4-8nT. The north-south component (Bz) was generally weakly negative (southward) with only brief positive (northward) spells, varying -6 nT to +5nT. Phi angle was mainly positive (away from the Sun). Geomagnetic activity has been Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at background. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was below the Active (1e8 integrated pfu) threshold. The fluence observation at 16/0000UTC was 2.98e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Very Low, but with a chance of rising to Moderate with any isolated M-flares. The most likely flare source is currently from the numerous filaments on the Earth-facing disc.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, with the anticipated CME from 10 Nov having either passed, or now expected to have no discernible impact. Any weak enhancement from CH70/- day 1 (16 Nov), is forecast to soon ease to background day 2 onward (17 Nov). No further enhancements are currently expected. Geomagnetic activity is forecast to be Quiet to Unsettled at first, perhaps rising to Unsettled with Active spells if any connection to CH70/- occurs. Otherwise easing to be mainly Quiet day 2 (17 Nov) onward.

Energetic Particles / Solar Radiation: GOES16 High energy proton flux is expected to remain at background. GOES16 High energy electron flux is likely to rise through the period as any elevated electron populations at lower orbits relax back towards GEO. This is low confidence however, especially with the potential for further weak enhancements to the solar wind on day 1 (16 Nov). The associated electron fluence is likely to remain below the Active threshold (1e8 integrated pfu) but confidence lower by days 3-4 (17-18 Nov).

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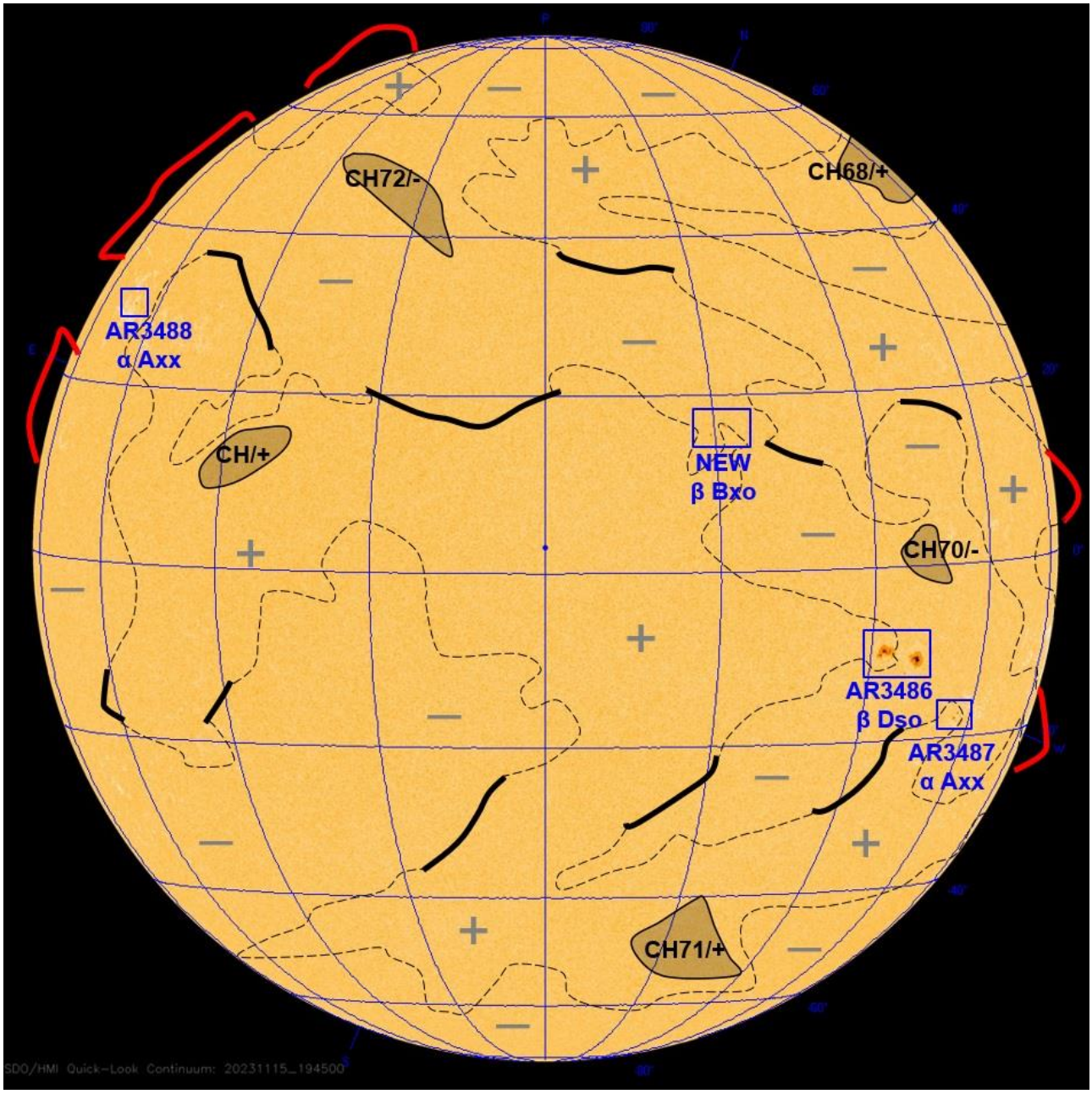
Figure 1. Solar Analysis Valid 15/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

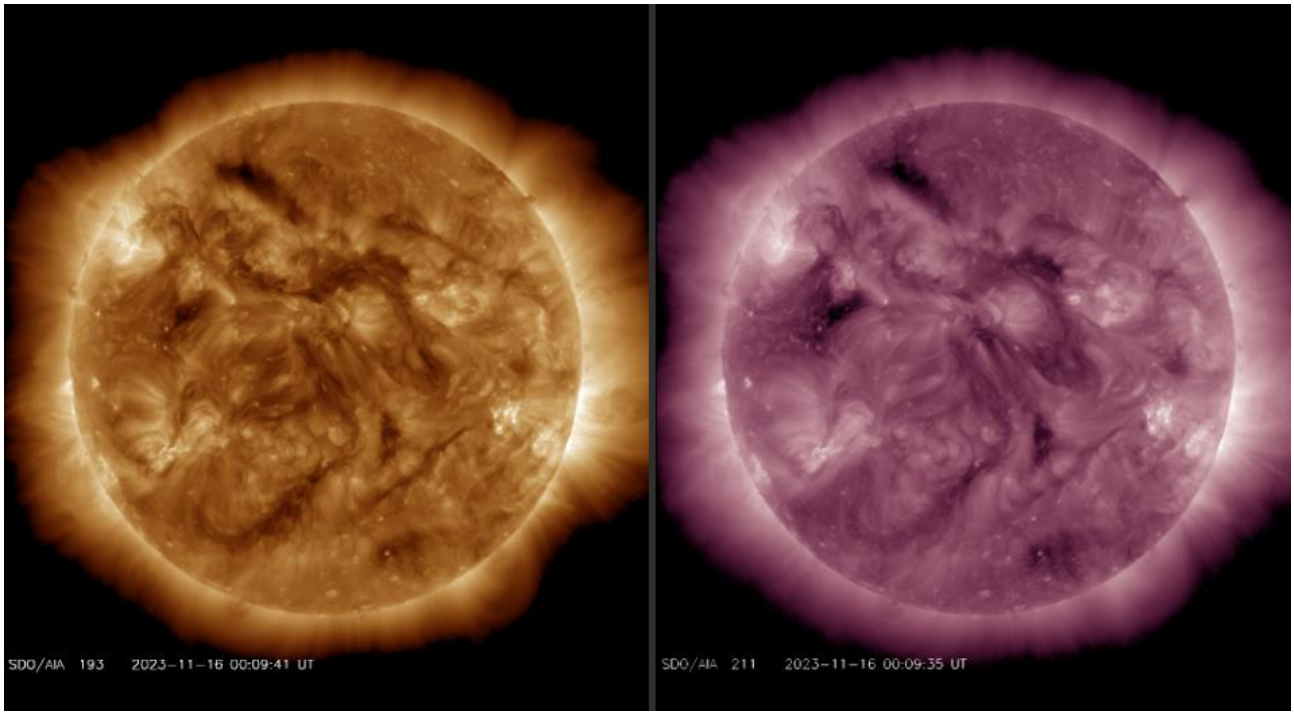
The slow CME from 10 Nov is now considered to have missed or perhaps been the cause of the weak enhancement observed on the 14th. There are currently no further Earth-directed CMEs.

CH70/- is the other main feature in the forecast. MOSWOC enlil would indicate a weak enhancement on 15 Nov, however this has not yet occurred. This increase may yet occur on day 1 (16 Nov), perhaps increasing winds to around 450 km/s, however this is low confidence. A return to mainly background winds is expected from day 2 (17 Nov).

Geomagnetic activity is forecast to be Quiet to Unsettled at first, perhaps rising to Unsettled with Active spells if any connection to CH70/- occurs. Otherwise easing to be mainly Quiet day 2 (17 Nov) onward.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO 193 and 211 imagery showing only small coronal holes.



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Radio Blackouts - X-Ray Flares:

Solar Activity is Low to Very Low, with only a slight chance of M-flares

There are currently four small sunspot regions on the disc, three of which are numbered. AR3486 is the largest, but remains a simple and inactive bipolar spot with no sign of further development. The other numbered regions are very small unipolar spots, while a very small newly emergent region in the northeast appears to have stalled in development.

The most notable activity on the disc is likely to come from any filament eruptions, with a couple of large filaments extending across the northern disc and also the southwestern disc. While these appear stable, C-flares, with a very low chance M-flares, are possible if they were to erupt.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	15	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/18 X-ray flux

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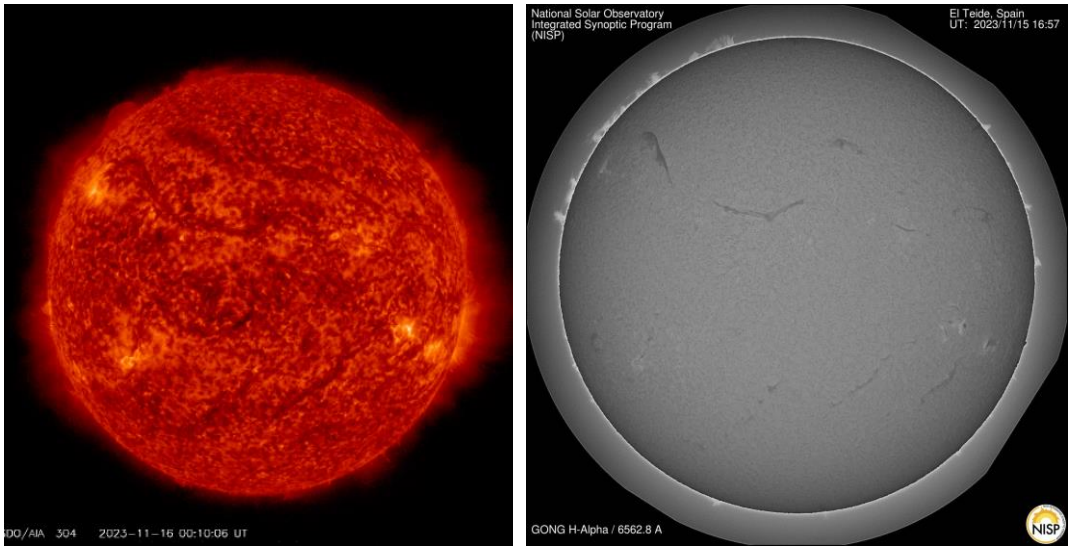
Solar Radiation Storms - (High Energy Protons):

The high energy (greater then 10Mev) proton flux observed by GOES16 is currently at background levels and expected to persist at this level. The main risk of any increase to the proton flux will be from any notable filament eruptions, however these are currently considered unlikely to reach the S1 level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO-304 imagery (left) and H-alpha imagery from El-Teide (right), showing the filaments on Earth-facing disc.



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High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) at GOES-16 has persisted at background, with recent solar wind enhancements increasingly likely to have only a minimal impact at GEO. Any fast wind connection on day 1 (16 Nov) is unlikely to significantly increase electron count rates, but alongside any increase due to the natural outward relaxation of electrons at lower orbits, will brings the potential for Moderate, perhaps briefly High, flux. This most likely by day 3 or 4 (18-19 Nov)

The associated 24 hour electron flux is expected to remain below the Active (1e8 integrated pfu) level but with decreasing confidence by days 3-4 (18-19Nov). This is supported by REFM, which is now considered to be giving good guidance for a least the next 24 hours.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES-16 Electron Flux and Fluence with REFM

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